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Records of 175,000 US Army service members with completed health risk appraisals were reviewed. The proportion of soldiers at risk for physical and/or emotional illness decreased significantly over time with an exact probability of p=1.07E-52. The sample was reduced to 1651 and divided into four groups as a function of risk status over time. Results were expected to show that soldiers with multiple appraisals reduced risk over time, and that the two high risk groups had lower related medical costs. However, there was a significant increase in each cardiovascular risk with $t(1649) = -2.85$, $p=.004$ for cholesterol; $t(1649) = -35.86$, $p=.000$ for smoke status; $t(1649) = -8.92$, $p=.000$ for systolic blood pressure; and $t(1649) = -6.17$, $p=.000$ for diastolic blood pressure. Risk category, age, and sex were expected to predict medical costs, however, the presence of only nine inpatient episodes demonstrated that inpatient admissions were not useful indicators of health care costs in active service members. Results suggested that cardiovascular risk in the active Army population is not influenced by the Army Health Risk Appraisal Program.

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MEMORANDUM THRU Preceptor (Major Ralph Sees, MS, Acting Deputy Commander for Administration)

FOR U.S. AMEDD Center and School, Bldg 2841 HSHA-MH (Rene Pryor), 3151 Scott Road, Fort Sam Houston, Texas, 78234-6100

SUBJECT: Graduate Management Project

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U.S. ARMY-BAYLOR UNIVERSITY
GRADUATE PROGRAM IN HEALTH CARE ADMINISTRATION

WORK-SITE HEALTH RISK APPRAISAL IN A MILITARY POPULATION: EFFECTS ON RISK STATUS AND MEDICAL COSTS

A GRADUATE MANAGEMENT PROJECT
SUBMITTED TO THE FACULTY
IN CANDIDACY FOR THE DEGREE OF
MASTER IN HEALTH ADMINISTRATION

BY

CAPTAIN ANGELA J. POWELL

FORT STEWART, GEORGIA

MARCH 1995

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ABSTRACT

Records of 175,000 U.S. Army service members with completed health risk appraisals were reviewed. The proportion of soldiers at risk for physical and/or emotional illness decreased significantly over time with an exact probability of p=1.07E-52. The sample was reduced to 1651 and divided into four groups as a function of cardiovascular disease risk status over time. Results were expected to show that soldiers with multiple appraisals reduced risk over time, and that the two high risk groups had lower related medical costs. However, there was a significant increase in each cardiovascular risk with $t(1649) = -2.85$, $p=.004$ for cholesterol; $t(1649) = -35.86$, $p=.000$ for smoke status; $t(1649) = -8.92$, $p=.000$ for systolic blood pressure; and $t(1649) = -6.17$, $p=.000$ for diastolic blood pressure. Risk category, age, and sex were expected to predict medical costs, however, the presence of only nine inpatient episodes demonstrated that inpatient admissions were not useful indicators of health care costs in active service members. Results suggested that cardiovascular risk in the active Army population is not influenced by the Army Health Risk Appraisal Program.

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INTRODUCTION

Conditions which prompted the study

Health care in the United States is a paradox of the world's most technologically and scientifically advanced medical practices combined with perhaps the least effective disease and injury prevention programs. For example, Americans will demand the availability of high cost, low efficacy treatment options, through state funded Medicaid programs; yet, they seem to place much less importance on the 11 million uninsured American children without access to primary care and preventive medicine services. This is partially responsible for the fact that the U.S. has a higher infant mortality rate compared to other developed nations (Kronenfeld 1993).

The fragmented health care delivery systems in the U.S. have started to change and will likely continue to transform in the next decade due in part to renewed political pressures. It is difficult to determine specific future developments given the unstable nature of such reform. The only thing known with any certainty is that health care resources will be scrutinized as never before in this country.

It is doubtful that the current economic situation can continue to support all of the advances in diagnostics and therapeutics that the medical community continues to develop. National health reformers have made a series of efforts to narrow the gap between high technology and limited access. C. Everett Koop established the roots of change with his 1979 Surgeon General's Report, followed in 1990 by the Healthy People 2000: National Health Promotion and Disease Prevention Objectives, and in 1994 by the President's Task Force for National Health Care Policy (Minkler 1994, U.S. Department of Health and Human Services 1990, U.S. Department of Health, Education, and Welfare 1979). These endeavors, while falling short of policy reformation, successfully focused the nation on the monetary and utilitarian merits of health and wellness promotion.

Managed health care groups see the financial benefits of maintaining health and primary care access for their defined populations. As an example, Kaiser Permanante offers its clients classes in smoking cessation, stress reduction, exercise and weight control, and cholesterol reduction for a nominal fee (Glover interview 1994). Kaiser, as well as other health maintenance organizations, believes these programs will effect positive behavior changes within their population leading to reduced overall costs per member. The Department of Defense (DOD), administering the nation's largest managed health care

delivery system, coined TRICARE, similarly adopted wellness objectives. The DOD's health promotion plan incorporates the U.S. Public Health Service's Healthy People 2000 goals. One may view the plan's purpose as threefold: (1) to reduce chronic disease risks in its entire beneficiary population, (2) to conserve the fighting strength of its active and reserve components, and (3) to ultimately reduce medical costs (U.S. Department of Army 1989, 1987).

Paralleling private sector managed care systems, and supporting the DOD plan, the Army Medical Department (AMEDD) increased its number of interventions to promote healthy lifestyles in its beneficiary population. In 1987, the AMEDD instituted a Health Risk Appraisal (HRA) program to facilitate identification and education of high risk beneficiaries. The program has local administration and funding, with centralized consulting from and reporting to the U.S. Army Medical Command (MEDCOM) (U.S. Department of Army 1989, 1987).

More recently, in 1995, the Army established a health promotion command. This new command will become the focal point for all wellness issues. It is intended to establish and publish the Army's health promotion mission, vision, and goals, and to streamline research in line with the central focus (Pugsley interview 1994).

Statement of the Problem

Although the AMEDD is redirecting health care efforts toward prevention, its system of health promotion activities remains in the infancy stage. Attempts to scientifically measure HRA program outcomes have been less than productive. Private sector health promotion projects face similar challenges. In addition to simply tracking the numbers of completed health risk appraisals, Army health promoters must seek empirical methods to measure the effectiveness of their programs in terms of decreasing high risk behaviors and controlling medical costs. Failure to capture, correctly interpret, and then appropriately respond to such data leads to misdirected use of health care resources.

Literature Review

Household outputs accounted for more than fifty percent of the total U.S. health expenditures in the 1950s. This payment scheme eroded with the passage of federal Medicare/Medicaid programs in 1965. The heavy influx of federal dollars lead to increases in physician specialty referrals, inpatient admissions, technological advancements, and ultimately to massive health care inflation. By the 1970s, health care payers lacked control over increasing chronic diseases, and health care costs. The U.S. Surgeon General responded by promoting public health education and intervention. Dr. Koop reported that a combination of

behavioral and environmental influences were responsible for America's rising chronic diseases. He stressed the importance of circumventing high cost, specialized medical care by reducing controllable risk factors (Levit and Cowan 1991, Sonnefeld et al 1991, Minkler 1994).

The Surgeon General's health promotion philosophy spawned a paradigm shift in the 1980s. Health care suppliers and consumers began to focus their interests from curing illness to maintaining health. As a result, health enthusiasts promoted the benefits of workplace wellness and health risk appraisal programs. Many payers viewed public and work site efforts designed to modify unhealthy lifestyles as reasonable measures to improve well-being and reduce future health care costs (Warner et al 1988).

To support that theory, researchers found significant empirical evidence relating poor lifestyle behaviors to the onset and/or exacerbation of costly chronic diseases. Risk factors associated with premature heart disease were particularly well-publicized. Certain modifiable behaviors were unquestionably linked with cardiovascular disease (CVD) risk. For example, increased blood pressure and serum cholesterol directly increased CVD risk. Smoking cigarettes and eating too many fatty foods indirectly increased risk; smoking tobacco products raised blood pressure and consuming a high fat diet increased serum cholesterol levels (Denke 1994, Ramsay, Yeo and Jackson 1991, Lipid Research Clinics

Program 1984b, LaRosa 1992).

Such increased attention facilitated scientific understanding, and public awareness, of potential interventions to lower the risk of coronary heart disease. As a result, Healthy People 2000 offered objective performance indicators to measure preventive efforts, in terms of effecting behavior change and positive health outcomes (U.S. Department of Health and Human Services 1990).

Despite proliferation of wellness initiatives, national health expenditures continue an upward spiral and will likely account for 16.4 percent of the gross national product in the year 2000. The significance of such an increase transcends household health care expenditures, with major economic impacts to corporate and government entities.

In the decades following the 1950s, health care payers shifted such that total health care costs were equally divided between public, employer, and household expenditures. Employers' health related expenses now constitute the fastest rising cost of doing business in the United States, with employer health care payments exceeding after-tax profits (Levit and Cowan 1991, Kronenfeld 1993, Sonnefeld et al 1991).

Disheartened voters from all payer groups led to the current administration's emphasis on health care reform. President Clinton's reform proposal provides universal

coverage, based on his belief that basic health care is a right for all Americans. His plan, as well as many other proposals, incorporates the preventive medicine concepts established by Dr. Koop and Healthy People 2000 (Minkler 1994). The basic premise is that, in redirecting medical care resources toward health maintenance, health care payers will save money currently spent on chronic disease management in more costly medical care settings.

The daunting task of reducing escalating health care bills faces private and military sector payers. Health care leaders particularly focus on reducing risks that lead to cardiovascular diseases, which remain America's major cause of death and disability, despite the increased public and scientific awareness of behavioral and therapeutic interventions (Robinson and Leon 1994).

Nearly half of all American adults are hypercholesterolemic, notwithstanding a decrease in mean serum cholesterol levels (Sempos et al 1993, Love 1993, Robinson and Leon 1994, Lipid Research Clinics Program 1984a, Barratt et al 1994, O'Brien and Chait 1994). While there are similar declines in the population's smoking rates, there is a significant difference between the proportions of military and civilian smokers. Military members are twice as likely to smoke as their civilian counterparts. Specifically, the Army smoking rate is 43.1 percent compared to the national rate of 25 percent (Hoffman

n.d.). According to a Department of Defense Worldwide Survey, smokers are likely to be less physically fit, and to cost the military more in excess physician visits and lost time due to illness than are nonsmokers (Hoffman n.d.).

Indeed, the number of unhealthy soldiers affects the Defense budget and potentially national security, in terms of increased medical costs and decreased readiness. Therefore, health promotion efforts must aim to identify, and then change, smoking and other behavioral risks associated with CVD. This is particularly important for individuals with a known history of the disease, whose risk of future CVD events are five to seven times greater than others of equal age (Robinson and Leon 1994, Lipid Research Clinics Program 1984b.

The children of soldiers with established premature coronary heart disease are another population of high risk beneficiaries. Such offspring are two to thirteen times more likely to develop coronary heart disease than are members of the general population (Langner, Rowe, and Davies 1994). Knowledge of defined population risk is critical under circumstances of scarce health resources. Langner, Rowe and Davies suggest increased benefit per cost of screening, followed by outcomes monitoring of these known high risk groups, over massive screening, absent follow-up, of the entire beneficiary population.

The health and economic benefits of modifying measurable CVD risks, including smoking, hypercholesterolemia, sedentary lifestyle, hypertension, and obesity, manifest within two to three years of intervention (Robinson and Leon 1994). Given today's economy, the time lag between investment and return is significant, irrespective of employee satisfaction or other social benefits. It can be a deterrent to the informed manager or commander's decision to begin, or continue, to fund health promotion programs. Conspicuously missing from the literature is a breadth of sound evidence directly linking health promotion efforts with reduced medical costs. To date, the reports are largely anecdotal, due more to the difficulties inherent in measuring such an association, rather than to the true strength of the relationship among variables (Warner et al 1988).

The University of Michigan (UM) reported on perhaps the most notable large scale health promotion outcomes study in a corporate setting. In response to escalating medical claims costs, Steelcase, Inc. contracted the University of Michigan Fitness Research Center to conduct its wellness program and to report the resultant changes in medical claims costs over time (Yen, Edington and Witting 1991).

The UM researchers began the study in 1985, with a representative sample of 1,938 Steelcase employees. Health risk status and medical claims data were monitored for three

consecutive years. Results of a chi-square analysis indicated a statistically significant positive relationship between health risk and medical costs in the sample (Yen, Edington and Witting 1991).

The UM study further reported the multivariate effect of health risks on both medical claims and absenteeism in a sample of 1,284 Steelcase workers. Both economic variables were reported to be affected by health risk status, with a stronger correlation between risk status and absenteeism costs. Multiple regression analyses of economic measures with age and sex subgroups showed that health effects on costs are age-sex specific. This kind of information is critical when marketing a health promotion plan to a diverse employee population (Yen, Edington and Witting 1992). Knowledge of which health promotion activities work for specific age-sex categories can lead to improved health outcomes and reduced medical costs.

The Minnesota Heart Health Program was the largest community based health risk appraisal effort specifically aimed at cardiovascular disease risk. Researchers measured cardiovascular risk change in response to an intensive education intervention. Morbidity and mortality outcomes were not evaluated. Results showed limited risk improvement in the study group compared with a similar control group. The researchers reasoned that the program's massive public education efforts may have "contaminated" the comparison

group, ostensibly leading to insignificant differences between groups. Such results indicate a need for education, paired with social environment change, to effect meaningful community risk reduction (Luepker et al 1994).

Two studies were found which narrow the scope of this review of literature. They report that health promotion activities influence one CVD risk, hypercholesterolemia, in the Department of the Army population (Love 1993, Powell, Lyons, and Rumph n.d.). While each intervention group decreased hypercholesterolemia risk over time, neither study examined changes in smoking, multiple CVD risks, coronary event outcomes, or the associated economic impact.

Purpose

This study examines the AMEDD's current HRA program for efficacy and areas in need of improvement. The purpose of the study was (1) to determine the effectiveness of the HRA screening process in promoting healthy behaviors which reduce CVD risk, and (2) to evaluate medical costs associated with different CVD risk groups.

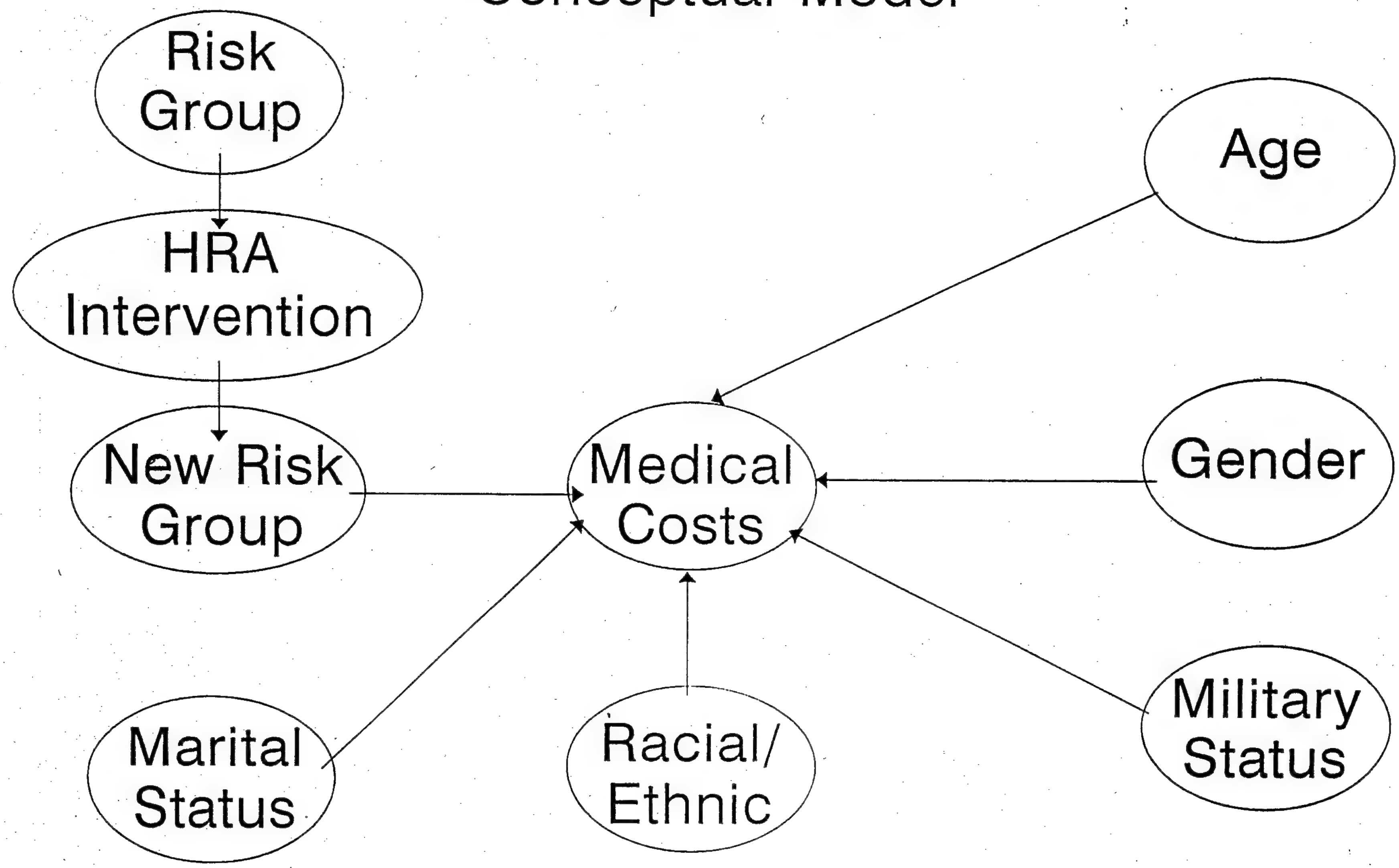
The theoretical model derives from established scientific evidence that individual lifestyle choices are associated with CVD risk. The scope narrows from the cardiovascular risks, to the impact of HRA intervention, to the related medical costs associated with onset and exacerbation of the disease. Figure 1 is the conceptual model for this study. The conceptual model depicts the

hypothesized relationship between the independent variables of CVD risk category, operationally defined as High (one or more CVD risks) or Low (otherwise); age (years); gender (male/not); military rank (enlisted/otherwise); marital status (married/not); racial/ethnic status (black/not; white/not; hispanic/not; other/not), and the dependent variable of outcomes, operationally defined as number of inpatient admissions classified as behaviorally-controllable, cardiovascular diagnostic related groups (DRGs).

Given this framework, it is logical to assume that the beneficiaries with greater than one health risk assessment intervention could reduce risk category over time and that those remaining in the high risk group could have greater negative outcomes, based on number of hospital admissions for DRGs related to CVD, than those in the low risk group. The demographic independent variables are expected to add to the combined effect of risk category.

FIGURE 1

Conceptual Model



METHODS AND PROCEDURES

Sample

The sample for the study consisted of 175,000 Department of the Army beneficiaries. All were active duty service members with at least one recorded health risk appraisal in 1991 and another in 1993. A more manageable subsample of 1651 was used for many of the statistical analyses. The composition of the subsample was limited to a random sample of service members with a baseline 1991 HRA and a follow-up 1993 appraisal.

Demographic data was available for 1643 soldiers in the subsample. The majority of all subsample subjects were male (90 percent) with an average age of 31 years. Overall the sample was 68 percent caucasian, 22 percent black, 6 percent hispanic, 1 percent asian, and 3 percent other ethnicity. The subsample was divided into four groups based on risk over time.

Instrumentation

Use of the U.S. Army Medical Command Health Risk Appraisal (HRA) and the U.S. Army Patient Administration System and Biostatistical Activity (PASBA) databases facilitated data collection. An HRA database manager

initially identified active duty U.S. Army soldiers with recorded appraisals between 1991 and 1993. He identified 175,000 individuals who met that criteria. He sent the resulting data, to include coded social security numbers and corresponding health risk status, for inclusion in this study.

Due to the immense amount of data, the HRA data manager performed a second search to limit the initial sample to soldiers with a baseline HRA in 1991 and a follow-up HRA in 1993. He provided their coded social security numbers with their matched responses to, and objective results from, the HRA questionnaire. This data included demographic and risk variable information.

The HRA data manager sent actual social security numbers of the subsample to the PASBA data manager. She used the PASBA database to match the identified respondents with their inpatient DRG data.

The DRG list below includes, but is not limited to, diagnoses associated with CVD risk behaviors (Powell interview 1994): 106,107 (Coronary Bypass); 108 (Other Cardiovascular or Thoracic Procedures); 111 (Major Reconstructive Vascular Procedures); 112 (Vascular Procedures Except Major Reconstruction); 113 (Amputation for Circulatory System Disorders); 115 (Permanent Cardiac Pacemaker Implant); 119 (Vein Ligation and Stripping); 120 (Other Circulatory System O.R. Procedures); 121,122,123

(Circulatory Disorders); 127 (Heart Failure and Shock); 129 (Cardiac Arrest, unexplained); 131 (Peripheral Vascular Disorders); 133 (Atherosclerosis); 134 (Hypertension); 139 (Cardiac Arrhythmia); 140 (Angina Pectoris); 143 (Chest Pain); 144,145 (Other Circulatory Diagnoses).

Reliability and Validity

The information collected in this study was from a retrospective review of an automated system of records; therefore, the researcher assumed reliability, or reproducibility, of measurement. The Department of Army assumed the validity of its HRA questionnaire to measure health risk (U.S. Department of Army 1989). The researcher assumed content validity for the PASBA data due to its objective nature and physician review of DRG categories.

Design

Service members were screened for CVD as part of the HRA Program. Active duty soldiers completed the HRA questionnaire during inprocessing at new duty stations, as part of routine physical examinations, or as a unit screen. A community health nurse typically evaluated each questionnaire, and then briefly provided basic risk factor education per individual risk profile. The nurse then referred at-risk individuals to a dietitian, smoking cessation class, or primary care physician, as appropriate

for risk and per local standard operating procedure. Medical Treatment Facility (MTF) community health nurses transferred monthly HRA questionnaire results to the MEDCOM HRA office via disk for long term storage.

The MEDCOM HRA database identified individuals with two or more HRAs, indicating multiple health promotion interventions over time. For the purpose of this study, interventions implied any health promotion information or education, provided at the time of questionnaire completion, which may have reasonably lead to positive, reactive behavior changes. Such information may have been written or verbal, and may have been limited to simply informing the soldier of his high risk behaviors.

The Microstat statistical program compared the proportions of soldiers identified with high health risk, using MEDCOM risk categorization, in 1991 versus 1993, based on aggregate data. A subsample of 1651 randomly selected records was then drawn for further analysis. The sample consisted of individuals with a baseline health risk appraisal in 1991 and a repeated appraisal in 1993. Using the Statistica software, by StatSoft, Inc., repeated measures t-tests were performed for each CVD risk variable, at time 1 (1991) and time 2 (1993), to compare the differences between means over time.

Using the same software program, individual records were put into one of four groups as a function of risk

category from time 1 to time 2. High risk records had serum cholesterol of 240 milligrams per deciliter or more; current smoker status; systolic blood pressure above 140 millimeters of mercury; and/or diastolic blood pressure above 90 millimeters of mercury. The risk status variable had binary coding; 1 if the individual possessed any one or more of the four cardiovascular risks, and 0 otherwise.

Descriptive demographic statistics were computed, using Statistica, for each group. Such data were expected to reveal differences in demographic characteristics of individuals with recorded health behavior changes. The dependent outcomes variable, individual admissions data derived from PASBA, was then added to the corresponding individuals within each risk group. No further statistical evaluation was needed due to the minimal number of inpatient admissions reported. Pearson's Product-Moment correlation was used to assess the strength of relationships between all of the variables.

Reducing Measurement Error

Use of a large sample and subsample maximized experimental variance. Use of data from the standardized HRA questionnaire and the PASBA database minimized the error variance. Extraneous variables were controlled through casewise and listwise deletions.

Ethical Considerations

The ethical rights of beneficiaries were protected throughout the study. All individual data was retrospective in nature and void of personal identifiers. This was accomplished through computerized coding of all sample members social security numbers prior to inclusion in this study.

THE RESULTS

Table 1 illustrates the sample's aggregate risk comparison. As expected with intervention, the proportion of soldiers at risk decreased significantly over time. Risk, for the purpose of this table, included any increased propensity for physical and/or emotional illness. The raw data came directly from the MEDCOM database.

TABLE 1
Risk Comparisons Over Time

	Risk Proportion	n
1991	.1104	90,420
1993	.0886	84,717
p=1.07E-52		

Table 2 depicts repeated measures for cholesterol, blood pressure, and smoking status within the subsample of 1651.

TABLE 2
Descriptive and Inferential Statistics by Time Interval

Variable	Mean	SD	t	p
Cholesterol				
1991	176.67	40.71		
1993	179.30	41.61	-2.85	.004
Smoke Status				
1991	.31	.46		
1993	.82	.39	-35.86	.000
Systolic BP				
1991	115.44	13.89		
1993	119.12	13.26	-8.92	.000
Diastolic BP				
1991	71.93	9.95		
1993	73.80	9.97	-6.17	.000

Note: n=1651 soldiers

These comparisons provide a more complete picture of each risk factor's change over time. The results illustrate an unexpected, significant increase in each risk variable over time within the subsample. Although all four risks increased, smoke status was the only variable that exceeded the normal, healthy population level. The amount of active service members who started to smoke, during the two years observed, increased by fifty percent. Mean cholesterol and both blood pressure values, at both time intervals, remained within normal limits. There were no significant correlations between demographic and risk variables that suggested a stronger risk relationship based on ethnic, age, gender, or other group association.

Aggregate CVD risk by year, for subsample individuals with complete data, provided another illustration of the surprising risk increase.

YEAR	HIGH RISK	LOW RISK
1991	664	979
1993	1410	233

Risk groups based on individual risk change over time were as follows:

GROUP NUMBER	RISK STATUS CHANGE 1991-1993	n
1	High to Low	79
2	Low to High	825
3	Remain Low	154
4	Remain High	585

Table 3 illustrates the comparison of mean demographic differences by group distribution. The majority of soldiers were enlisted, young white males. Mean ages in the low risk groups were surprisingly higher than those in the high risk groups, yet this correlation did not exceed the critical value of significance.

TABLE 3
Demographic Statistics of Subsample by Group

	n	%		n	%		n	%
			GENDER					
Male						**Female**		
Group 1	76	96					3	4
Group 2	800	87					25	13
Group 3	129	84					25	16
Group 4	538	92					47	8
			MILITARY RANK					
Enlisted						**Officer**		
Group 1	79	100					0	0
Group 2	751	91					74	9
Group 3	146	95					8	5
Group 4	579	99					6	1
			MARITAL STATUS					
Married						**Not Married**		
Group 1	53	67					26	33
Group 2	446	54					379	46
Group 3	111	72					43	28
Group 4	375	64					210	36
			ETHNIC/RACE					
White			**Black**			**Hispanic**		
Group 1	56	71		15	19		3	4
Group 2	511	62		206	25		74	9
Group 3	111	72		30	20		3	2
Group 4	386	66		135	23		35	6
Asian			**Other Ethnic**					
Group 1	1	1		4	5			
Group 2	8	1		25	3			
Group 3	0	0		9	6			
Group 4	6	1		23	4			

	Mean	SD
AGE in 1991		
Group 1	30.70	9.14
Group 2	27.84	7.70
Group 3	33.12	8.32
Group 4	30.67	8.12

Note: n=1643 soldiers

DISCUSSION

The results were expected to show that soldiers with multiple HRAs reduced health risk over time, and that groups 2 and 4, high risk at time 2, had higher medical costs than the low risk groups. The actual findings, however, did not wholly support that hypothesis. While there was a significant time related decline in mean overall health risk within the larger sample, there was an increase in each risk specific to cardiovascular disease within the subsample. Risk category, age, and sex were expected to predict medical costs, consistent with the literature. However, the presence of only nine inpatient episodes with a CVD related diagnosis demonstrated that inpatient admissions were not useful indicators of health care costs (outcome) in an active duty population. Accordingly, the research hypothesis was not accepted.

Changes in the study's design could have altered the outcome. For example, if the study design defined the dependent outcome variable as overall health risk status, rather than as medical costs, the alternate hypothesis would have been accepted based on the results in Table 1. This approach, although undoubtedly less complex than the study's design, would not increase the body of empirical data

relating specifically to CVD risk. Secondly, outpatient visits could have been used as the dependent variable representing medical costs. Although outpatient visits are unquestionably a more appropriate measure of medical costs for an active duty population, they were rejected during the study's design due to inadequate centralized outpatient data within the Army's system of records.

Alternatively, changing the dependent variable to combined CVD risk, or any one of the four measured CVD risks, would not have changed the study's outcome. In either of these cases, increases in each of the four CVD risks from time 1 to time 2 (significant at the $p<.05$ level) would clearly demonstrate that CVD risk is not positively influenced by the HRA intervention. As a result, the research hypothesis would not have been accepted.

The study's most significant and alarming finding was the number of young soldiers who began to smoke during the two year period. Nearly half of the subsample began smoking from time 1 to time 2. These soldiers, in group 2, were not at risk for CVD in 1991. By 1993, however, they were considered at risk due to smoking initiation. It was smoking, rather than the other CVD risks, that moved soldiers from a low to a high risk group. Based on the review of literature, many of the negative health effects from smoking do not present for several years. As a result, there may be some value in measuring the subsample's medical

costs in five or more years.

There were limitations to this study. First, a subsample was needed to reduce the amount of data analyzed by the various software programs. Ideally, the study would have included the entire sample in all analyses. However, automation resources available did not have enough memory to handle the comparisons. Second, the design of this study required a lot of coordination and dependence on agencies that were outside of the researcher's control and local area. Although this was frustrating and time consuming, it highlighted the problems with the Army's decentralized databases. This data would have been more easily and completely collected and analyzed if the local HRA, the MEDCOM HRA, and the PASBA data were in the same network, and outpatient data were included.

The future implementation of the ambulatory data system should facilitate collection of centralized outpatient data to enable outcomes monitoring despite frequent soldier moves. Future studies on the active duty population will be aided by improvements in the automated health information systems.

CONCLUSIONS AND RECOMMENDATIONS

In summary, this study suggests that CVD risk from elevated serum cholesterol, smoking, and hypertension, in the U.S. Army population, is not influenced by the Army Health Risk Appraisal Program. The HRA is an appropriate tool to identify these risks, however, the associated education interventions in soldiers identified as at risk do not appear to be effective. During the two year study period, mean serum cholesterol, smoking rate, and blood pressure levels significantly increased in soldiers provided HRAs. Age and gender were not found to be significant predictors of risk or inpatient medical costs, as indicated by the high probability that the relationships were due to chance alone.

The results from this study can be used by commanders and clinicians working with the AMEDD Health Risk Appraisal Program. The study illustrates that while overall health risk can be reduced over time with the current risk intervention, cardiovascular disease risk is not affected. This finding is particularly important since the high smoking rate within the young enlisted subsample is indicative of the same trend in the entire enlisted population.

Commanders and clinicians often direct, or at least highly encourage, participation in weight control and cholesterol reduction classes for soldiers found to exceed the standards. Although it is clear, based on this study's results, that smoking is a more pervasive health risk, there appears to be much less command and/or medical emphasis on smoking cessation.

Until the health promotion command develops its policy and establishes direction, the Army will continue to run a decentralized, loosely defined, health promotion program. As installation medical advisors, individual MTF commanders are ultimately responsible to maintain the health of the active duty soldiers within their catchment areas. The HRA is intended as a tool for these commanders to identify, and then appropriately respond to, health problems.

Certainly, some HRA and health promotion programs are superior to others. Further studies should be conducted to measure local health promoter's abilities to effectively manage risk in an installation's active duty population.

Since the HRA tool identifies CVD risks, yet the larger health promotion program is not effective in reducing risk over time, MTF commanders should make one of two decisions: (1) task their local HRA program manager to redesign the current program (marketing specific high cost/high volume risks or groups), and monitor and report outcomes with associated medical costs over time, or (2) discontinue

funding the program and redirect the resources to other programs that may deliver positive outcomes and reduced medical costs.

In either case, MTF commanders must analyze their HRA Program as they begin to redirect scarce medical resources within their catchment area. Officers in charge of Health Risk Appraisals, and other health promotion ventures, can no longer expect program funding based on the idea that their efforts will somehow improve soldier health and readiness. Competition for resources, within a capitated budget, requires clinicians to develop a strong business acumen. They, like their civilian counterparts, are challenged to demonstrate their program's benefit, in terms of health improvement and cost containment.

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